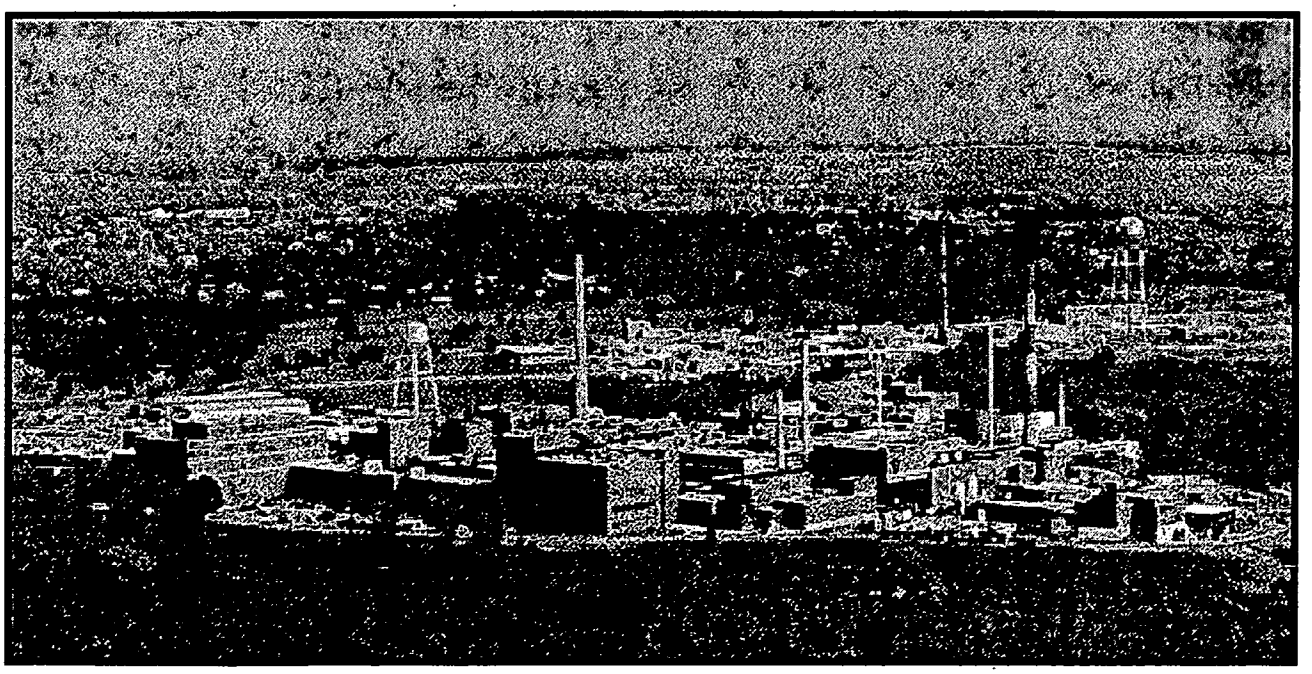
3005-060501001 5

Environmental
Restoration
Program

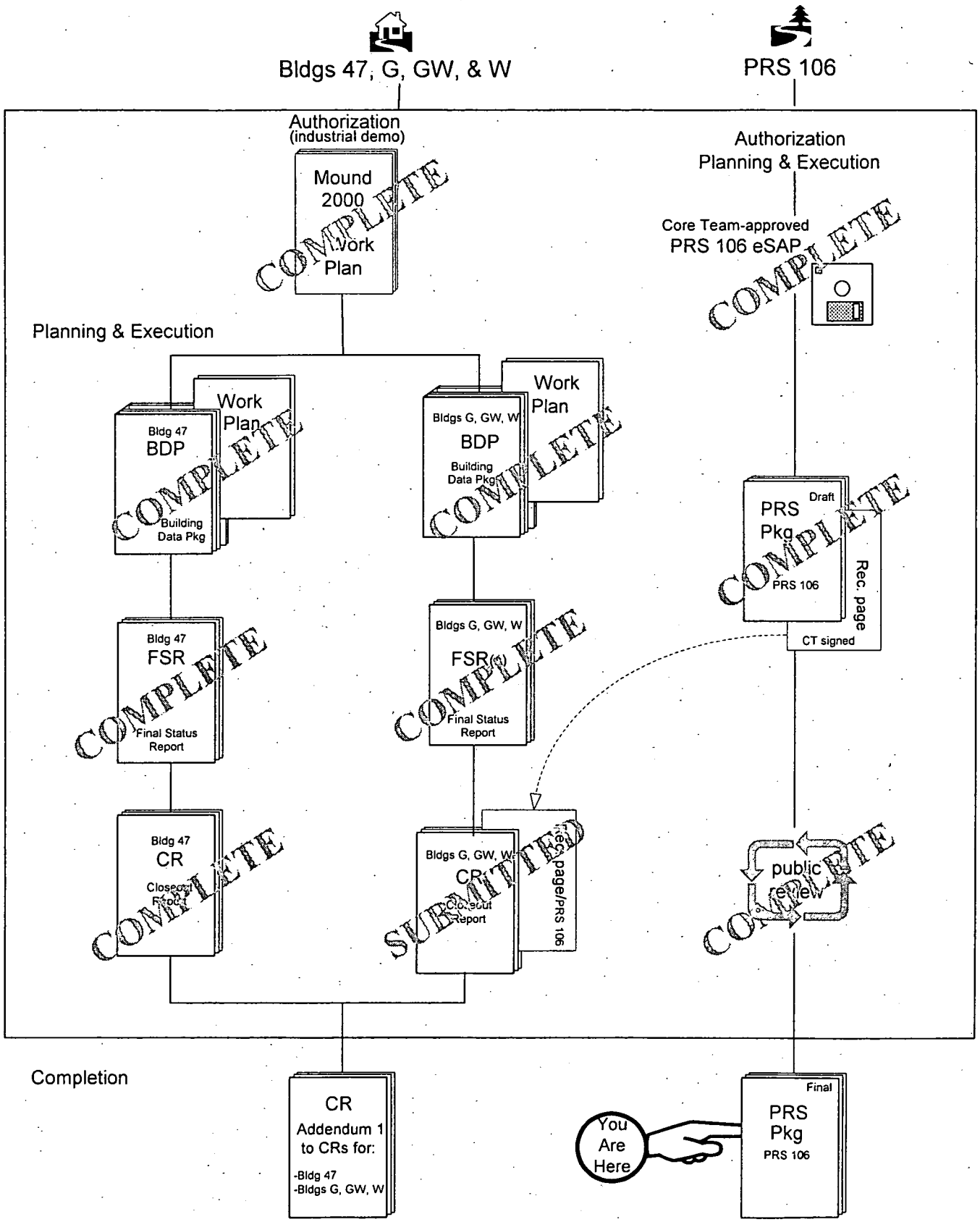
Miamisburg Closure Project
Potential Release Site Package

PRS 106

Final
January 2005



Bldgs 47, G, GW, & W + PRS 106



4Jan05

The Mound Core Team
500 Capstone Circle
Miamisburg, OH 45342

January 2005

Mr. Frank Bullock, PE
Director of Operations
Miamisburg Mound Community Improvement Corporation
720 Mound Road
COS Bldg. 4221
Miamisburg, Ohio 45342-6714

Dear Mr. Bullock:

The Core Team, consisting of the U.S. Department of Energy Miamisburg Closure Project (DOE-MCP), U.S. Environmental Protection Agency (USEPA), and the Ohio Environmental Protection Agency (OEPA), appreciates your comments on the PRS 106 PRS Package, Public Review Draft, November 2004. Attached is our response.

Should the responses to comments require additional detail, please contact Paul Lucas at (937) 847-8350, x314 and we will gladly arrange a meeting or telephone conference.

Sincerely,

DOE/MCP:	Paul Lucas Paul Lucas, Remedial Project Manager	1/4/05 date
USEPA:	Timothy J. Fischer Timothy J. Fischer, Remedial Project Manager	1/4/05 date
OEPA:	Brian K. Nickel Brian K. Nickel, Project Manager	1/4/05 date

Response to MMCIC/ EHS Technology Group, LLC Comments on the PRS 106 PRS Package Public Review Draft November 2004

Comment 1.

Reference Document: PRS 106 Data Package, Public Review Draft, November 2004

Purpose: The purpose of this document is to notify the public of the status (No Further Action) of the Potential Release Site (PRS) 106.

Assessment of Review: EHS has had the opportunity to review and comment on this PRS Data Package. We concur with the planned No Further Action status for PRS 106. This data package was prepared in accordance with the requirements specified in the *Work Plan for Environmental Restoration (ER) of the DOE Mound Site, The Mound 2000 Approach.* As such, all appropriate inquiry was made into the condition of the potential release site.

Technical Analysis: PRS 106 consists of the soils under the G Building. The G Building is the location of the garage for the site. This garage was constructed in 1947 and placed into service in 1948. It served as the site's garage until its demolition in 2003. The garage was used for vehicle maintenance and parking. Because of its use, the building was suspected of causing gasoline or solvent contamination to the soils below the building slab.

Several sampling activities were performed at this PRS. A site wide radiological scoping survey was conducted during the 1980's. During this sampling, only two contaminants of concern were sampled. These included plutonium 238 (Pu-238) and thorium 232 (Th-232). All detected levels in the vicinity of PRS 106 were well below cleanup standards. In addition, a soil vapor survey was conducted in 1995. The potential risk from the detected soil vapor concentrations was compared to the Soil Vapor Screening Level. All detections were well below the calculated Soil Vapor Screening Levels.

In 2004, additional soil sampling was performed at PRS 106 after the slab for the G Building was removed. Four samples were collected in areas suspected to contain contamination due to cracks in the concrete or drainage from the building. Although one sample had Benzo(a)pyrene above the Risk Based Guideline Value, there was no concentration detected above the Risk Based Cleanup Objective.

Finally, an evaluation was made to determine if any volatile organic compounds (VOC) or polycyclic aromatic hydrocarbons (PAH) could leach through the soils, causing contamination to the groundwater. A methodology was used to compare soil contaminant concentrations to the calculated "soil screening levels for leaching to groundwater". In all cases it was determined that the soil result is less than the calculated soil screening levels for leaching to groundwater.

Substantive Comments: EHS concurs with the No Further Action recommendation for the soils under the G Building, called PRS 106. We understand that sampling in the area has determined that all soils contaminants are below the cleanup objective and calculations show little potential for leaching to the groundwater. Therefore, this PRS should not present a significant environmental concern at the site.

Coordination between CH2M Hill, the DOE and MMCIC to ensure the PRS 106 area is left in a condition consistent with the Mound Reuse Plan.

If EHS's understandings are correct, no specific response to the above comment is necessary, and we understand that these comments will be included in the OSC report.

Response 1. Thank you for your review and input to the document. Public comments are included in the final version of the document to which they pertain; accordingly, these comments will not be included in an OSC Report as your comment indicated, but are included in the Final version of the PRS 106 PRS Package.

MMCIC is encouraged to coordinate with DOE and the clean-up contractor regarding end-state plans. The demolition Work Plan for Building G specifies any site restoration activities that follow structure removal. The Core Team understands MMCIC's request and encourages MMCIC to meet with DOE to obtain an agreeable end state.

MIAMISBURG CLOSURE PROJECT

POTENTIAL RELEASE SITE PACKAGES

The following three documents are available (November 29, 2004) for public information in the CERCLA Public Reading Room, 305 E. Central Ave., Miamisburg, Ohio.

PRS 106 (soil below G Building)
PRSs 211/212 (A Building Tanks)
PRS 271 / PRS 336 (Building 37 Tanks)

Questions can be referred to Paul Lucas at (937) 847-8350 ext. 314

U.S. Department of Energy
U.S. Environmental Protection Agency
Ohio Environmental Protection Agency

PRS HISTORY:

PRS 106, G Building Soils, is the location of the site's former garage (location indicated on Figure 1). The garage was constructed beginning in 1947 and was completed and placed into service as the site vehicle maintenance facility in 1948. It continued to serve this function nearly until its demolition in 2003. The garage was also used for overnight parking of some site vehicles. Because of its use for vehicle maintenance and parking, the garage was suspected of causing gasoline or solvent contamination in the area. Indeed soil contaminated with gasoline was removed from the vicinity in 1986-7 [1]. This contributed to the listing of G Building soils as a potential release site, although no specific instances of spills were cited [2].

For a period of several months in 1955 the garage was used for interim storage of drums containing thorium ore source residues. There was no thorium processing in the garage. Upon completion of the interim drum storage the garage floor was scrubbed and decontaminated. Post decontamination surveys indicated that the garage floor was free of radiological contamination [3].

CONTAMINATION:

A Vistamap search of sampling under and around the G Building slab revealed the sample locations shown on Figure 2. These locations include both historic and recent samplings.

Historic Sampling

Site-wide radiological scoping surveys were conducted in the 1980s, during which Pu-238 and Th-232 were the primary contaminants of concern [4]. Only 2 radiological detections, for Pu-238, were found among the historic sample locations under and around G Building, at S0137 and S0141. Each was less than 0.7 pCi/g, well below soil screening levels of 55 pCi/g. Th-232 was not detected in the historic samples. Radiological information is reported for completeness and documentation.

Because of a concern for contamination by organic solvents at locations across the Main Hill, including the vicinity of G Building, a soil vapor survey was conducted [5]. Vapor surveys were considered relatively simple and indicative of organic analytes in soils. Many locations were sampled across the Main Hill; see the figure on page 5 of Attachment 1. Chemical detections from the soil vapor survey that are relevant to PRS 106 are presented in Attachment 1 and summarized in Table 1, below.

TABLE 1: Maximum Detected Soil Vapor Concentrations, Compared to Calculated Soil Vapor Screening Levels

Analyte	Location/ Depth	Maximum Conc. (ppb)	Calculated Soil Vapor Screening Level (ppb)
1,1,1-trichloroethane	4004/2 ft	2982.5	18,900,000
1,1-dichloroethane	4005/2 ft	<1481.5	73,200,000
Freon-11 (trichlorofluoromethane)	4006/2.5 ft	<535.7	NA

NA: not available

The potential risk from each of these detected soil vapor concentrations was evaluated by comparing against its unique Soil Vapor Screening Level. This level is the soil vapor concentration that would be measured in soil with a VOC concentration corresponding to the applicable soil guideline value (more restrictive of the 10^{-6} Risk-Based Guideline Value (RBGV) or the value for which Hazard Index (HI) equals 0.1). Calculation of Soil Vapor Screening Levels has been done in previous PRS packages according to published methodology [6,7]. Attachment 2 provides a copy of Reference [6]. Soil Vapor Screening Levels for the VOCs relevant to PRS 106 are calculated in Attachment 3 and are also shown in Table 1.

Comparisons of VOC concentrations to Soil Vapor Screening Levels are favorable in Table 1. The detections were well below the calculated Soil Vapor Screening Levels.

Recent Sampling

Because the vapors of some organic contaminants were observed in soils surrounding G Building, as noted above, the concern arose that these contaminants may have originated from below the slab of G building. The G-GW-W Buildings Data Package therefore states that "PRS 106, Garage Area Soils, will be sampled after the G-Building slab is removed. The sampling data will be presented to the Core Team to determine if further action is needed. The Core Team's recommendation will be included in the G-GW-W Buildings Closeout Report" [8]. Pursuant to this commitment, a sampling and analysis plan was prepared [9] and approved by OEPA [10]. References [9] and [10] are provided as Attachment 4.

Following the removal of the G-Building slab, soil below the slab was sampled in February 2004 and analyzed for VOCs and polycyclic aromatic hydrocarbons (PAHs). Samples were collected from four locations that were either associated with slab discontinuities or deemed to have the potential for ingress of contamination. These locations are indicated as PRS106-A, -B, -C, and -D on Figure 2. Analytical results are given in Attachment 5. Detections were compared to soil guideline values (10^{-6} RBGV or 0.1*HI). In only one case, for Benzo(a)pyrene at location PRS-106A, does a detected concentration exceed the 10^{-6} RBGV. However, the concentration does not exceed a 10^{-5} RBGV-based Cleanup Objective (CO), as shown in Table 2.

TABLE 2: Soil VOC or PAH Concentrations > Guideline Values, Compared to Soil Cleanup Objective and Soil Screening Value for Leaching to Groundwater

Analyte	Location	Detected result	RBGV (10^{-6})	CO	SSL_{LGW}
Benzo(a)pyrene	PRS106-A	1.22 mg/kg	0.408 mg/kg	4.08 mg/kg	11.31 mg/kg

GROUNDWATER CONTAMINATION POTENTIAL: The concern that VOCs or PAHs could leach from PRS 106 soil to cause contamination in Buried Valley Aquifer (BVA) groundwater was investigated. Evaluation methodology has been previously described [11], and is reprinted here as Attachment 6. Using these methods, Attachment 7 calculates soil contaminant concentrations for detected analytes in PRS 106 soils that could lead to the maximum contaminant level (MCL) in the groundwater (or to the groundwater's 10^{-6} RBGV or 0.1*HI, if MCL is not available). The attachment then compares these calculated "soil screening levels for leaching to groundwater" (SSL_{LGW}) to observed soil data. The maximum detected concentrations of VOC and PAH in the four recent PRS 106 samples are compared, as are the VOC soil concentration derived from detected soil gas reconnaissance data (Attachments 1 and 2). Attachment 7 states in conclusion that: "In all cases the highest analytical soil result is less than the calculated SSL_{LGW}" and that "...the compounds detected in the soils pose no risk via leaching to the underlying groundwater system." The SSL_{LGW} value for benzo(a)pyrene is included in Table 2 for information.

REFERENCES:

[1] US Department of Energy, Operable Unit 9, Site Scoping Report, Volume 7 – Waste Management (Final), February 1993, section 6.1.1.11.

[2] US Department of Energy, Operable Unit 9, Site Scoping Report, Volume 12 – Site Summary Report (Final), December 1994, page A.1-12.

[3] DOE Mound Facility Miamisburg, Ohio, The Garage (G Building) General Support Function Documentation Package, BWXTO of Ohio, Inc., November 2001.

[4] R. L. Stought, D. A. Edling, and D. G. Draper, The Mound Site Survey Project for the Characterization of Radioactive Materials in Site Soils, May 16, 1988 and US Department of Energy, Operable Unit 9, Site Scoping Report, Volume 3 – Radiological Site Survey (Final), June 1993.

[5] Soil Vapor Reconnaissance Operable Unit 2, Main Hill OU-2 Phase I Technical Memorandum, February 1995.

[6] Potential Release Site Packages, Reading and Understanding, Volume II (Preliminary), August 8, 1996, Attachment D3, "Screening Potential Release Sites based on Soil Gas Readings", DOE Mound Facility, Miamisburg, Ohio.

[7] USEPA/540/F-95/041, Soil Screening Guidance Fact Sheet, Attachment C, Chemical Properties for SSL Development, July 1996.

[8] Miamisburg Closure Project, Building Data Package, G-GW-W Buildings (Demolition), Final, September 2003, Volume 1 of 3, section 4.2.3.

[9] E-mail, K. Arthur to D. Seely, P. Lucas, and B. Nickel, November 13, 2003, "106 eSAP FINAL that includes VOCs".

[10] E-mail, K. Fox to D. Rakel, M. Wiliams, D. Seely, D. Punch, and P. Lucas, November 25, 2003, "PRS 106eSAP FINAL".

[11] Potential Release Site Packages, Reading and Understanding, Volume II (Preliminary), August 8, 1996, Attachment D4, "Standardized Equations based upon USEPA Soil Screening Guidance for the Soil to Ground Water Migration Pathway", DOE Mound Facility, Miamisburg, Ohio, and references cited therein.

ATTACHMENTS:

1. Historic Soil Vapor Reconnaissance Data (Reference [5], selected pages)
2. Screening Potential Release Sites based on Soil Gas Readings (Reference [6])
3. Calculation of Soil Vapor Screening Levels for Detected PRS 106 Soil Gas Analytes
4. E-mail references [9] and [10] regarding PRS 106 eSAP
5. February 2004 VOC and PAH Soil Sampling Results from PRS 106
6. Standardized Equations based upon USEPA Soil Screening Guidance for the Soil to Ground Water Migration Pathway (Reference [11], pages 1-5)
7. Evaluation of Potential for Leaching of Volatile Organic Compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs) from PRS 106 Soils into Groundwater

PREPARED BY:

John Gill, CH2MHill, ER Technical Staff
Gary Miller, CH2MHill, ER Technical Staff
Karen M. Arthur, CH2MHill, ER Technical Staff

MIAMISBURG CLOSURE PROJECT
PRS 106

RECOMMENDATION:

PRS 106 is the soil underlying the site's former garage (G Building). An historic soil vapor survey found no chemical contamination above Soil Vapor Screening Levels in the soil immediately adjacent to the garage. Recent characterization sampling and analysis of the underlying soil detected no contamination above soil Cleanup Objectives. No screening levels based on projected leaching of VOCs or PAHs into groundwater are exceeded. Available data supports that radiological contamination is within acceptable risk (10^{-5}) for industrial reuse.

Therefore, the Core Team recommends **No Further Assessment** for PRS 106.

A PRS Package with an NFA recommendation signed by the Core Team will be placed in the Public Reading Room for a 30-day review period. Upon closure of the public review comments, if any, the PRS Package will be issued as a final document and made available in the Public Reading Room.

The final Core Team recommendation sheet from this evaluation will be included in the G-GW-W Buildings Closeout Report.

CONCURRENCE:

DOE/MCP:	Paul Lucas	11/17/04
	Paul Lucas, Remedial Project Manager	(date)
USEPA:	Timothy Fischer	11/17/04
	Timothy Fischer, Remedial Project Manager	(date)
OEPA:	Brian K. Nickel	11/17/04
	Brian K. Nickel, Project Manager	(date)

FIGURE 1: Location of PRS 106

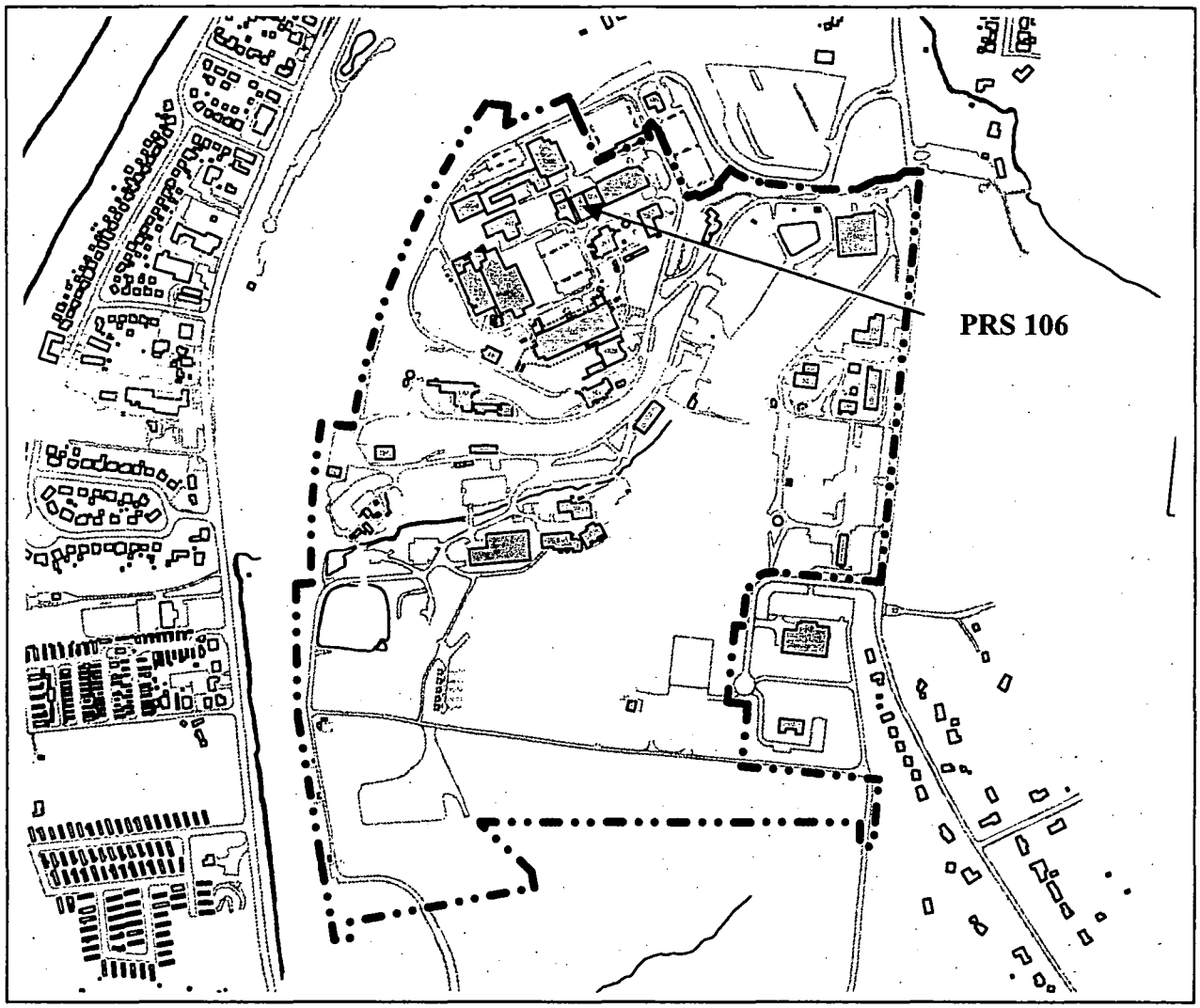
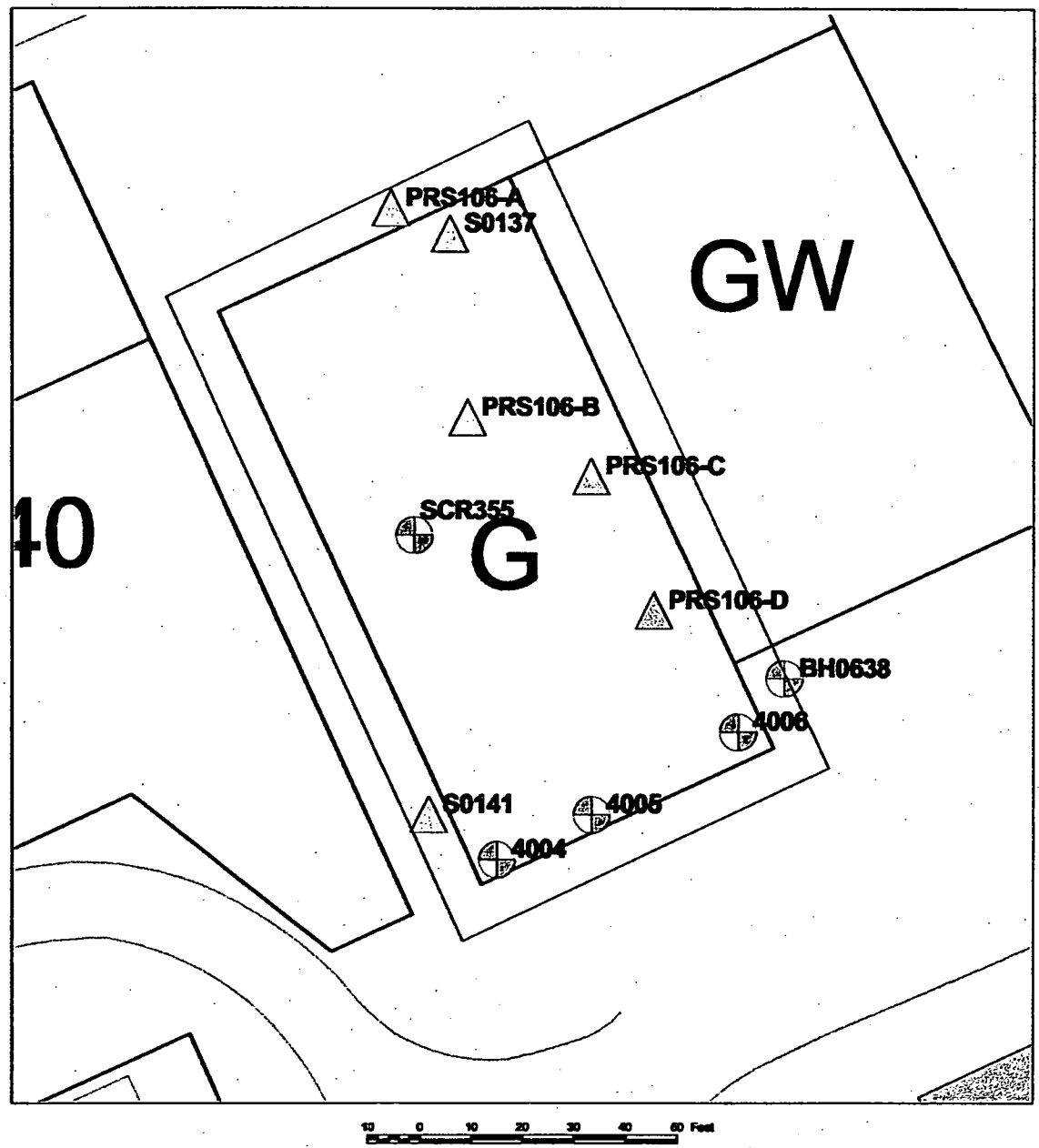


FIGURE 2: Historic and Recent Sample Locations around PRS 106



Soil Samples
Soil Boring
Surface Sample

06/07/04

ATTACHMENT 1

HISTORIC SOIL VAPOR RECONNAISSANCE DATA (REFERENCE [5], SELECTED PAGES)

Environmental Restoration Program

SOIL VAPOR RECONNAISSANCE OPERABLE UNIT 2, MAIN HILL OU-2 PHASE I TECHNICAL MEMORANDUM

MOUND PLANT MIAMISBURG, OHIO

February 1995

FINAL

(Revision 0)

Department of Energy
Ohio Field Office

Environmental Restoration Program
EG&G Mound Applied Technologies

ATT. 1, P1 of 7

1. INTRODUCTION

1.1. SITE BACKGROUND

Mound Plant originated as part of the Manhattan Engineer District in 1943; its purpose was to determine the chemical and metallurgical properties of polonium (DOE 1986). The work was performed for the U.S. Army at several locations in Dayton, Ohio, by Monsanto Research Corporation (MRC 1985). In 1946, 182 acres were purchased for the permanent Mound Plant Site on the outskirts of the city of Miamisburg, in Montgomery County, Ohio (Figure 1.1). The Site is approximately 10 miles south-southwest of Dayton and 45 miles north of Cincinnati. In 1948, work being performed at the Dayton units was moved to this Site, and in January 1949, operations involving radionuclides began.

Early Mound Plant programs investigated the chemical and metallurgical properties of polonium-210 and its applications, particularly the fabrication of neutron and alpha sources for weapon and nonweapon use. Investigations involving uranium, protactinium-231, and plutonium-239 were performed from 1950 to 1963 as part of the national civilian power reactor program. In 1954, separation of the stable isotopes of noble gases began. Development of plutonium-238 heat sources started at Mound Plant in 1961 because of its high specific activity and relatively short half-life (87.74 years). Since that time, heat sources fueled with plutonium-238 have been developed and fabricated.

In 1957, a new mission assigned to Mound Plant was the development, production, and surveillance of detonators for military applications. Development of explosives timers in 1959 led to their manufacture starting in 1963. The development and manufacture of ferroelectric transducers and firing sets (components that control initiation of detonators) began in 1962. All these programs are continuing.

The first of several programs requiring tritium-handling technology was initiated in 1958. Today, Mound Plant has an extensive capability for handling and studying tritium and tritium compounds for weapons or nonweapons applications. A facility also exists for the recovery and purification of tritium from all types of wastes generated at DOE sites which handle tritium. Facilities also exist for the development of tritium-containing materials and processes for weapons applications and possible manufacture (MRC 1985).

On the Main Hill, several buildings had a history of practices that included the use of chemicals. Organic solvents were used or stored in the GW Building, Paint Shop, DS Building Solvent Storage Shed, M Building, E Building Solvent Storage Shed, B Building Solvent Storage Shed and Building 28. Waste oils, fuel oils, gasoline, and diesel fuel were used in the G Building, B Building, and Building 28. The WD

Building also treated wastes from these buildings (DOE 1994c). Solvents were used as cleaning agents during manufacturing processes while waste oils were often the by-product of metal cutting during manufacturing.

In the early 1970s, as national concerns about the environment and the conservation of resources grew, Mound Plant expanded its comprehensive programs in environmental control, waste management, and energy conservation. In January 1975, Mound Plant formally came under the jurisdiction of the Energy Research and Development Administration upon dissolution of the Atomic Energy Commission (AEC). In October 1977, Mound Plant was incorporated into the DOE complex.

Mound Plant was placed on the CERCLA (Superfund) National Priority List (NPL) in November, 1989. Pursuant to that status, a CERCLA Section 120 Federal Facility Agreement (FFA) was signed between DOE and EPA (Administrative Docket Number V-W-90-C-075), and became effective October 12, 1990. A Remedial Investigation/Feasibility Study (RI/FS) was initiated at Mound to characterize the nature and extent of risks faced by uncontrolled hazardous waste and for evaluating potential remedial options.

In response to being placed on the NPL, an Environmental Restoration (ER) Program was initiated by DOE at Mound to fulfill its obligations under the FFA. The site was divided into Operable Units to simplify the investigation and program management (DOE 1992b). The Main Hill of Mound Plant (Figure 1.2) is OU-2. Operable Unit 2 comprises the portion of the site where the majority of the research and manufacturing took place.

1.2. OBJECTIVE

The objectives of the OU-2 RI/FS is to define the nature and extent of contamination on the Main Hill, characterize the risks to human health and the environment posed by exposure to affected medium, to evaluate potential remedies and to determine the affect of potential releases of contaminants to groundwater. The objectives for Phase I of this investigation, was to obtain information to help establish the scope for the subsequent phases of the investigation. As part of Phase I, a soil vapor survey was performed.

The soil vapor survey performed during this investigation was a reconnaissance sampling effort. This data will be used during the scoping of the Phase II sampling effort to determine which areas need further investigation. Specifically, the soil vapor survey was performed to identify areas of the site containing volatile organic compound (VOC) contamination within the subsurface soils that had not been identified during previous soil vapor investigations.

from three to 23,142 ppb. Most of the detections were in the B Building Solvent Storage Shed area, HH Building and Building 17.

Based on the results of this investigation, "hot spots" of contamination were centered at the B Building Solvent Storage Shed, Building 17, and the west side of the B Building.

The contamination at the B Building Solvent Storage Shed lead to an interim remedial action to remediate the soils in the area (DOE 1993). Soil vapor extraction (SVE) was the selected method of remediation and remedial efforts began in May of 1994. Initial soil vapor results indicated that concentrations of TCE ranged from less than 50 ppb to 2,650 ppb and 1,2-DCE (cis and trans) ranged from 100 ppb to 277.9 ppm (DOE 1994b). Since remediation began, concentrations of TCE have dropped to a maximum of 1,560 ppb and 1,2-DCE to 1,410 ppb.

1.4. FACTORS INFLUENCING SAMPLE LOCATIONS

1.4.1. Historical and Current Use of Buildings

Historical and current use of buildings, along with the data gaps from previous investigations, had the greatest influence on sample locations. Contaminants of concern had been or had potentially been used in all of the buildings investigated. The exceptions are the degradation products of tetrachloroethene and trichloroethene which are 1,2-dichloroethene (cis and trans) and 1,1-dichloroethane. Toluene may not have been used in a building but is a chemical found in gasoline and oil. The following sections describe the historical and current use of buildings to provide a rationale for their use in selecting sample locations. Specific sample locations are shown in Figure 1.3.

1.4.1.1. G Building - Garage

The garage is used to maintain the automobiles, trucks, buses, and heavy duty equipment used at Mound. The building is approximately 122 ft by 62 ft and is made of structural steel and brick with concrete floors. The building contains a new parts storage area, offices, restrooms, and a custodial operations storage area. Maintenance operations include oil changes, antifreeze replacement, vehicle repair, and tire and battery replacement. Building G is also used to store janitorial supplies such as floor strippers, floor finishes, cleansers, deodorizers, hand soaps, sponges, and mops that are used throughout Mound. These materials are stored in locked cabinets and caged areas. The historical and current use of this building indicated that the underlying soils may be contaminated with either motor oil, antifreeze, or organic based cleaning material. For that reason, samples were collected from locations that were

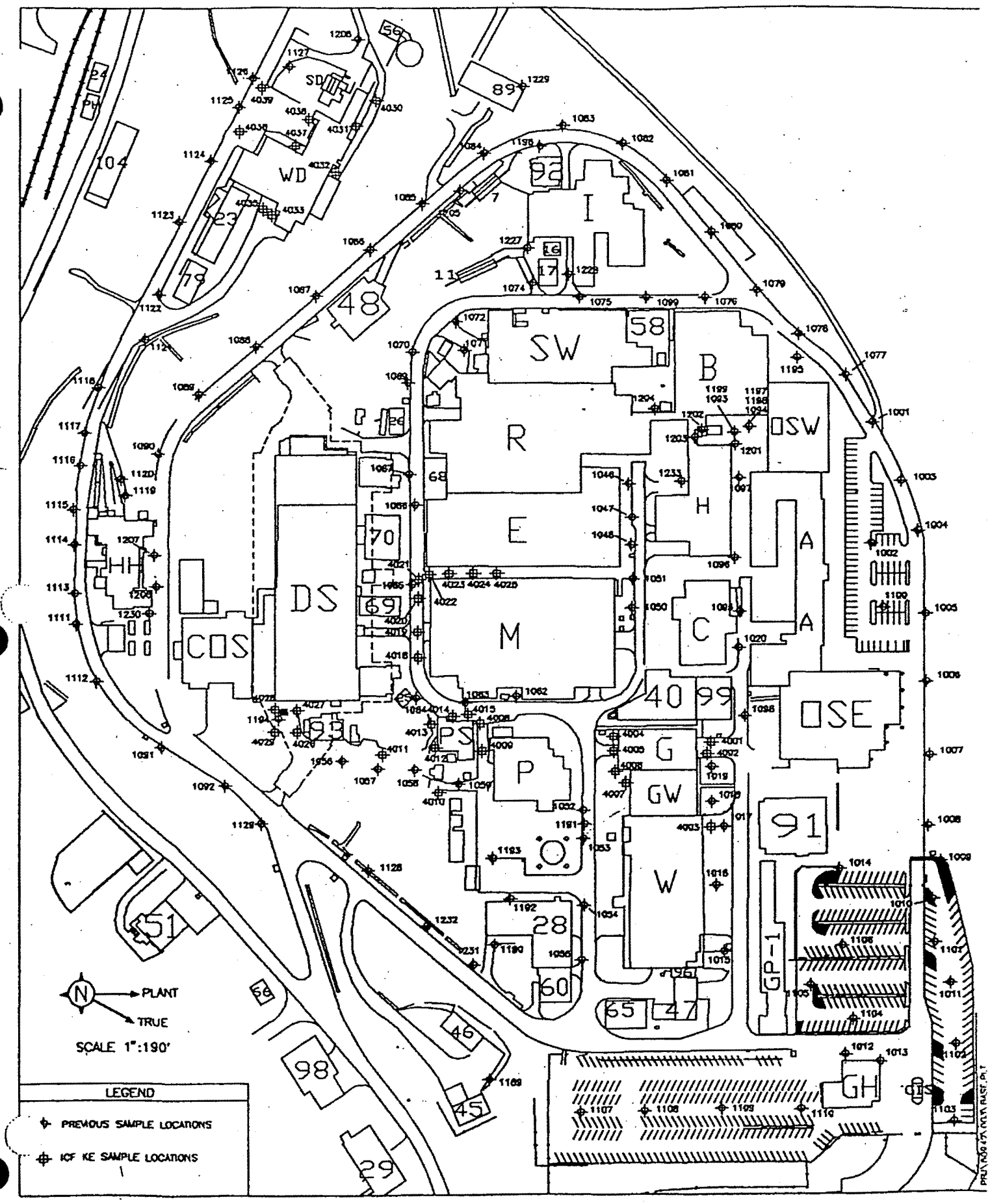


Figure 1.3. Sample Locations

judged to be areas where spills could collect or enter the soil. Specific locations were selected based on surface drainage patterns and obvious cracks in the overlying concrete.

1.4.1.2. Paint Shop

The paint shop began operating in 1963. The shop is used for both maintenance and production parts painting. Maintenance work includes the painting of such items as racks and furniture. Production work includes the painting of metal shipping containers, styrofoam shipping trays, and test panels. All painting is done inside spray booths. Based on the high use of solvents in this building, it was determined that samples should be collected around the building. Specific locations were based on the drainage patterns from the building to the surrounding areas, the surface drainage patterns of the surrounding areas and obvious cracks in the concrete. Some locations were also influenced by underground utilities.

1.4.1.3. Building M - Plating Shop

The Mound plating shop started in the M Building in the late 1940s (Figure 1.2). Plating processes and metal purification experiments were performed there. The shop itself consisted of eight to ten 150-gallon plating solution tanks that were handmade from boiler plate steel (Shawhan 1991). Sulfuric acid anodizing solution wastes and sodium hydroxide cleaning wastes were regenerated on an infrequent basis. The plating solutions were reused and generally recycled; but, when necessary, they were dumped into a large underground tank. The tank consisted of a concrete vault structure west of the original M Building that connected to the plant sanitary sewer. The cascade rinse systems also drained to the underground tank. The condition of this tank will be discussed in the OU-2 subsurface utility investigation. Soil sampling will be conducted as part of Phase II activities.

In 1962, a production plating shop and a general plating shop were installed in the M Building, and the old plating shop was dismantled. During the dismantling process, the plating solutions were removed from the equipment and neutralized. All of the old tanks and equipment were removed. The underground tank was retained and reconnected to the new equipment.

In 1981, a new production plating shop was built on the south end of the M Building. In 1985 or 1986, a new general plating shop was built next to it. The new shops were built to upgrade the old equipment and use modern technology. The old equipment still exists in the M Building, but has been cleaned out. The waste products were drummed and disposed of off-plant through the waste management system.

Soil Vapor Analytical Results, M Building								
Location	Depth (ft)	1,1,1-TCA (ppb)	Toluene (ppb)	PCE (ppb)	Freon 11 (ppb)	Trans-1,2-DCE (ppb)	Cis-1,2-DCE (ppb)	Total VOC (ppb)
4019	5.0	ND	ND	ND	<3,035.7	ND	ND	<3,035.7
4019	7.5	ND	ND	ND	<3,035.7	ND	ND	<3,035.7
4018	2.5	ND	526.3	ND	4,285.7	ND	ND	4,812
4018	5.0	ND	<526.3	3,235.3	ND	ND	ND	<3,761.6
4020	2.5	3,333.3	1,052.6	ND	22,500	4,297.9	3,787.9	34,966.8
4020	5.0	<1,403.5	789.5	ND	3,750	<2,020	<1,767.7	<9,730.9
4020	7.5	ND	789.5	ND	9,107.1	<2,020	1,767.7	<13,684.5
4020	12.5	1,403.5	ND	ND	6,428.6	ND	ND	7,832.1
4020	15.0	<1,430.5	ND	ND	5,714.3	ND	<1,767.7	<8,885.5
4020	17.5	ND	ND	ND	5,535.7	<2,020	2,777.8	<10,333.7
4020	19.7	ND	ND	ND	<2,857.1	ND	ND	<2,857.1

ND - Nondetect ppb - parts per billion J - qualified as estimated

3.5. G AND GW BUILDINGS

Six compounds were detected around G and GW Buildings. Freon 11 was detected at three locations at concentrations ranging from less than 536 to 2,321 ppb. Cis and trans-1,2-DCE were each detected at one location at a concentration of 1,768 ppb. 1,1,1-TCA was detected at two locations at concentrations of 1,404 and 2,983 ppb. Toluene was detected at one location at a concentration of less than 526 ppb. 1,1-DCA was detected at one location with a concentration of less than 1,482 ppb. The total volatile organics detected ranged from less than 536 to 7,787 ppb. The analytical results for these buildings are presented in the appendices and are summarized in the following table.

Soil Vapor Analytical Results, G and GW Building								
Location	Depth (ft)	1,1,1-TCA (ppb)	Toluene (ppb)	trans-1,2-DCE (ppb)	cis-1,2-DCE (ppb)	Freon 11 (ppb)	1,1-DCA (ppb)	TVOC (ppb)
4002	2.0	ND	ND	ND	ND	<535.7	ND	<535.7
4003	1.5	1,403.5	<526.3	1,767.7	1,767.7	2,321.4	ND	<7,786.6
4004	2.0	2,982.5	ND	ND	ND	ND	ND	2,982.5
4005	2.0	ND	ND	ND	ND	ND	<1,481.5	<1,481.5
4006	2.5	ND	ND	ND	ND	<535.7	ND	<535.7

ND - Nondetect ppb - parts per billion J - qualified as estimated

ATTACHMENT 2

SCREENING POTENTIAL RELEASE SITES BASED ON SOIL GAS READINGS (REFERENCE [6])

SCREENING POTENTIAL RELEASE SITES BASED ON SOIL GAS READINGS

Soil gas readings can be utilized in the PRS screening process to identify potential release sites that may present a potential soil contamination problem for volatile organics. The soil gas survey that was conducted at Mound as part of the "Reconnaissance Sampling Report–Soil Gas Survey and Geophysical Investigations, Mound Plant Main Hill and SM/PP Hill" investigated 8 volatile compounds. The concentrations of these compounds in the vapor phase within the pore spaces of the soil can be correlated to the actual soil contaminant concentrations by utilizing a method developed by ICF Kaiser Engineers. This technique has been used with US EPA Region IX approval at a large Superfund site contaminated with many of the same chemicals found at relatively low levels in soils at the Mound Plant.

The soil concentration can be estimated from the soil gas values by the following equation:

$$Ct = (Cg/Pb)*[[Pb * Kd / H] + [pw / H] + [pt - pw]]$$

where

Cg	concentration of volatile chemical concentrations as soil vapor in ng/ml
Pb	Bulk density of the soil in g/ml
Kd	soil/water partition coefficient in ml/g
H	Dimensionless Henry's Law Constant
pw	water filled porosity
pt	total porosity
Ct	target soil concentration in ng/g or ug/kg (ppb)

The technique that Mound Plant will use for screening a PRS is to compare the soil gas values obtained at a PRS with soil gas concentrations that are known to be below any regulatory or health based level of concern. The risk based guideline values for the Mound Plant (DOE, December 1995) soils are based upon 10^{-6} risk levels or a hazard index of 1. These values correspond to direct soil exposure to persons whose activities place them at the highest risk, in particular inhalation and ingestion by a Mound Plant construction worker.

Another potential exposure path must be considered, however. The potential for some of the organic contaminants to leach into ground water must be considered in developing protective soil screening levels. A "Mound Plant Soil Screening Level" paper explains the calculation of soil screening levels. For all of the chemicals that the soil gas survey identified, the calculated soil screening level soil concentrations are below the standard guideline values, therefore they are more conservative and are appropriate to be used as the basis for the soil gas calculations.

By re-arranging the equation, and using either the soil guideline values or the soil screening levels as the target soil concentration, a soil gas concentration can be calculated; this calculated soil gas concentration can be compared to the actual observed soil gas values:

$$Cg = (Pb*Ct)/[[Pb*Kd/H] + [pw/H] + [pt-pw]]$$

The values of the soil specific and chemical parameters for this equation are summarized as follows:

Pb	1.6	Bulk density of the soil in g/ml
pw	0.15	water filled porosity
pt	0.43	total porosity
foc	0.02	fraction organic material in soil (used in developing the SSL values)

5/20/96

Typical chemicals that are detected with soil gas sampling are:					
NAME	H	Kd	Calculated Acceptable	Calculated Acceptable	Calculated Acceptable
			Soil Screening Level Value	Soil Gas Reading	Soil Gas Reading
		ml/g	mg/kg (ppm)	ng/ml	ppb
Toluene	2.52E-01	3.42	22.06	1.56E+03	414600
1,1 Dicholorethane (DCA)	2.36E-01	0.7	5.70	1.61E+03	398000
Trichloroethene (TCE)	4.35E-01	2.24	0.07	1.26E+01	2400
111 Trichloroethane (TCA)	7.63E-01	2.2	3.01	9.46E+02	173400
Trans-1.2 Dichloroethene (DCE)	2.29E-01	1	0.70	1.41E+02	35700
cis-1.2 Dichloroethene (DCE)	1.85E-01	2.78	0.31	1.97E+01	5000
Freon 11	NA	NA			
Freon 113	NA	NA			
Tetrachloroethene (PCE)	7.09E-01	2.78	0.09	2.13E+01	3100

na—not available

IF THE SOIL GAS READING IS BELOW THE VALUES IN THE CALCULATED SOIL GAS READING COLUMN (SHADED), THEN THERE IS NO THREAT TO GROUNDWATER FROM THIS PRS.

The soil screening level values are calculated using the Soil Screening Methodology. The Potential Release Site is assumed to be more than 100 meters from a potential drinking water source with an aquifer thickness of 15 meters and a source size of 10 meters. The hydraulic gradient is assumed to be 0.01 which is conservative for most of the Mound Plant PRSs. In special instances where the PRS lies less than 100 meters from a potential drinking water source, or the hydraulic gradient is much less than 0.01, new SSL values and new acceptable soil gas values will be calculated for that particular PRS.

ATTACHMENT 3

CALCULATION OF SOIL VAPOR SCREENING LEVELS FOR DETECTED PRS 106 SOIL GAS ANALYTES

CALCULATION OF
SOIL VAPOR SCREENING LEVELS
FOR DETECTED PRS 106 SOIL GAS ANALYTES

Soil vapor concentrations corresponding to guideline values in soil (more restrictive of 10^{-6} RBGV or HI=0.1 value) were calculated using the methodology described in the Attachment 2 (Reference [6]) for analytes detected in G Building / PRS 106 soil gas sampling. The spreadsheet on page 2 of this Attachment 3 details the conversion from guideline values in soil to calculated screening levels for vapors in equilibrium with the soil (i.e., Soil Vapor Screening Levels), as well as the equations and analyte specific parameters needed for the conversion. The analyte specific parameters are available in USEPA tables [7].

The equation for Soil Vapor Screening Level, Cg, in units of ng/ml or μg/ml is taken from the second equation of Attachment 2 (Reference [6]). Cg expressed as ppb by volume (ppbv) is the value given for Soil Vapor Screening Level in Table 1 of the main text. Note that the chemicals listed in the table on page 2 of Attachment 2 were only typical examples of volatile chemicals that may be encountered at Mound and were not meant to be inclusive of all possible chemicals. That table therefore did not include DCA at the time of its creation (1996). Note also that several chemical-specific parameters given in the table on page 2 of Attachment 2 have been superceded. In particular the guideline value for TCA, given in the spreadsheet on page 2 of this Attachment 3, supercedes that given on page 2 of Attachment 2.

Derivation of Soil Vapor Screening Levels from soil target guideline values (10^{-6} RBGV or 0.1*HI)

Pb	1.6	soil density, g/ml
pw	0.15	water filled porosity fraction
pt	0.43	total porosity fraction
foc	0.02	fraction organic content in soil (determines Kd)

	molecular weight	Soil Target (0.1HI or 10^{-6} risk-based guideline value)	Henry's const	soil/water partition coeff	Soil Vapor Screening Level	Soil Vapor Screening Level	Soil Vapor Screening Level (molar basis, 295K)
chemical name	MW (g/mole)	Ct (mg/kg)	H	Kd (ml/g)	Cg (μg/ml)	Cg (ng/ml)	Cg (ppbv)
1,1,1-trichloroethane (TCA)	133.5	331	0.763	2.2	104	104,048	18,863,837
1,1-dichloroethane (DCA)	99	1060	0.236	0.7	300	299,575	73,239,935
Trichloroflouromethane (Freon-11)	137.5	73	NA	NA	NA	NA	NA

Cg (μg/ml) = Cg (mg/L) = (Pb*Ct)/[(Pb*Kd/H)+(pw/H)+(pt-pw)]

Cg (ng/ml) = 1000 x Cg (μg/ml)

Cg (ppbv) = Cg (ng/ml) * 22400*(295.25/273.25)/MW

where: 22400 = standard ml / mole of vapor
295.25 = temperature, degrees Kelvin
273.25 = standard temperature, degrees Kelvin

ATTACHMENT 4

E-MAIL REFERENCES [9] AND [10] REGARDING PRS 106 eSAP

From: Karen Arthur
To: DavidSeely; Lucas, Paul; Nickel, Brian
Date: 11/13/03 10:53AM
Subject: 106 eSAP FINAL that includes VOCs

Final eSAP 106
distributed via email on 13 Nov 03
NOTE: only change from prior version is BTEX to VOC, see bold below.

~~Brian:~~

After a lengthy site walk and several brainstorming discussions with Kathy Lee about our coordinated sampling at G Bldg, I propose the following plan. The plan proposes collecting one more sample than previously discussed (from 3 to 4) for completeness of evaluation. I have described both parties sampling under one cover so that you can see the overall coverage which is very good for such a small area. Additional detail is included so that you have information on the basis for a map with sample symbols on it. Also keep in mind that the entire footprint is only something like 60'x120', as well the available data in the area are below screening levels. Monte is promoting this quick confirmation to support the PRS and give actual sample results below the slab, or find contamination if it is present.

Please keep in mind that although BTEX/PAH-like yuks are a contaminant set with high mobility, there is a huge luxury not afforded by rad contamination; you can see and smell garage-related yuks. This is important to keep in mind because not only are you less likely to miss this type of contamination (if present) because of visual/smell indicators, but you can further refine sample locations based on those indicators.

I have built in some "2xbias" sampling locations that will be fixed after the slab is up. 2xbias sample locations are first biased to a particular pathway (location of pipe run, floor trench, cracks in pavement, expansion joints, tank, or other yuk-related feature). The first pass of sample placement considered these features, if present (all were evaluated for potential inclusion). An additional biasing is based on visual/smell indicators, if any. This allows for some sample locations to float linearly or within an area, and be fixed after the slab is up and other indicators can be used.

Our samples:
As shown on the enclosed figure, we have selected four surface locations that are evenly distributed over the surface area in question but are biased to specific features. All four samples will be submitted for **VOC** (EPA **Method 8260, A-027) analyses** & PAH (SW-846 8270, A-028). ~~This is the same analysis suite used at PRS 398.~~ Rationale for location (A-D) as shown on the figure is as follows:

Location A: Damaged asphalt pavement at/just exterior to the garage door.
Location B: intersection of recessed floor drain and concrete slab expansion joint
Location C: provides coverage to the central portion of the garage (this one is not really necessary)
Location D: along a 4" pipe that drains the recessed floor drain

Your samples:
Location E: near former waste oil tank, (reportedly removed) that would be/would have been located nearly on the footer between G and GW. A sample collected on the G side of the footer would allow for confirmation of impact/no impact from that concrete tank. The CT previously binned the tank NFA.
Location F: along an expansion joint that is missing some 'caulk' within the joint, possible pathway
Locations G & H: locations to be assigned after slab is up based on visual indicators, if any (wild cards) can be anywhere within the G Building footprint

What next?
~~If you will please discuss this with your staff, we can ensure that sufficient support is available to~~

~~accommodate your samples. If you have any questions or concerns about what we have proposed, please just call and we will talk it to satisfactory conclusion.~~ As the project moves closer to slab removal, we will alert you to the timetables so you can coordinate with your labs etc. If you would respond with "Brian concurs" or the like as we discussed, it would be appreciated.

Closure:
We will put together a PRS Pkg to include results of the sampling effort for CT binning. Once the recommendation sheet is signed, it will be included in the G Bldg Closeout Report which will then go final. If it gets an NFA., the Pkg and Closeout Report are the end of the document trail. If it gets anything other than NFA., the Closeout Report still goes final and ER will walk the PRS the rest of the way with whatever else is required based on binning.

~~Kathy Lee: please call asap if I explained your part wrong, else..... I know where you and Brian stand on this but want to record it accurately~~

~~David: This is an unbinned PRS. All available information gives no indication of a problem but ER has opted to collect some samples and add some data prior to submitting the PRS Pkg for binning. Based on a request by OEPA, we are discussing it together so that their samples get collected and we don't duplicate effort. Please call if you have any questions. We plan to move on this as soon as the slab is up, which may be a week or a couple months, but we need to be poised to jump on it as soon as the slab comes up.~~

regards
Karen
3007

CC: Darnell, Val; Fox, Kathy; Jendrek, Eugene; Punch, Danny; Rakel, David; Williams, Monte

From: "Kathy Fox" <Kathy.Fox@epa.state.oh.us>
To: <RAKEDA@doe-md.gov>, <WILLMA@doe-md.gov>, <Seely.David@epamail.epa.gov>, <Danny.Punch@ohio.doe.gov>, <Paul.Lucas@ohio.doe.gov>
Date: 11/25/03 11:42AM
Subject: PRS 106eSAP Final

At the direction of Brian Nickel, Project Manager, Ohio EPA Office of Federal Facilities Oversight, this email is to notify DOE MCP that the Final eSAP 106 as received on November 11, 2003, via email from Karen Arthur, is acceptable.

Please notify Ohio EPA (Kathy Lee Fox) two weeks prior to the planned sampling so that arrangements can be made with Ohio EPA's contract laboratory. If there are any questions, please contact Brian Nickel at (937) 285-6468 or Kathy Lee Fox at (937) 285-6441.

CC: <ARTHUR@doe-md.gov>, <DARNVK@doe-md.gov>, <jendef@doe-md.gov>, "Becky Hegyi" <becky.hegyi@epa.state.oh.us>, "Brian Nickel" <Brian.Nickel@epa.state.oh.us>, <Clipp@gw.odh.state.oh.us>

ATTACHMENT 5

FEBRUARY 2004 VOC AND PAH SOIL SAMPLING RESULTS FROM PRS 106

PRS 106 Garage Sub-Slab
VOA Results

	MDL	PQL	PRS-106 A	PRS-106 B	PRS-106 C	PRS-106 D	LCS	Blank
Analyte	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	% recovery	µg/kg
1,1,1-Trichloroethane	0.192	1.12					88	
1,1,2,2-Tetrachloroethane	0.106	1.12					75	
1,1,2-Trichloroethane	0.145	1.12					85	
1,1-Dichloroethane	0.180	1.12					84	
1,1-Dichloroethylene	0.163	1.12					90	
1,2-Dichloroethane	0.0929	1.12					83	
1,2-Dichloroethylene (total)	0.442	2.24					84	
1,2-Dichloropropane	0.220	2.24					87	
2-Butanone	2.81	11.2					66	
2-Hexanone	1.02	11.2					71	
4-Methyl-2-pentanone	0.194	11.2	*0.797*				78	
Acetone	3.86	22.4					74	
Benzene	0.226	1.12					84	
Bromodichloromethane	0.145	1.12					89	
Bromoform	0.128	2.24					87	
Bromomethane	0.243	2.24					94	
Carbon disulfide	0.154	2.24					92	
Carbon tetrachloride	0.124	1.12					89	
Chlorobenzene	0.106	1.12					86	
Chloroethane	0.232	1.12					90	
Chloroform	0.208	1.12					84	
Chloromethane	0.199	1.12					78	
Dibromochloromethane	0.135	1.12					92	
Ethylbenzene	0.19	1.12					94	
Methylene chloride	0.241	1.12					86	
Styrene	0.148	2.24					97	
Tetrachloroethylene	0.210	1.12		*1.31*			90	
Toluene	0.351	2.24	*1.15*	*0.657*	*0.734*	*0.541*	81	***0.345***
Trichloroethylene	0.186	1.12					87	
Vinyl chloride	0.164	1.12					87	
Xylenes (total)	0.740	3.36					89	
cis-1,3-Dichloropropylene	0.149	1.12					91	
trans-1,3-Dichloropropylene	0.149	1.12					96	
System Monitoring Cmpds	(% Recovery)							
1,2-Dichloroethane-d4	74-121		97	99	100	101	90	97
Bromofluorobenzene	85-128		101	101	101	102	104	102
Dibromofluoromethane	86-114		98	98	101	97	97	102
Toluene-d8	80-120		102	102	103	103	104	103
	Italic results are detections below practical quantitation level (PQL)							
	Blanks cells are non-detects (< MDL)							
	Bold results are outside QC criteria							

PRS 106 Garage Sub-Slab
Polyaromatic Hydrocarbons (PAH)

		PRS-106 A	PRS-106 B	PRS-106 C	PRS-106 D	LCS
Analyte		mg/kg	mg/kg	mg/kg	mg/kg	% recovery
Acenaphthene		*0.34*	*0.058*	< 0.0374	*0.042*	79
Acenaphthylene		< 0.154	< 0.0346	< 0.032	< 0.030	78
Anthracene		0.928	*0.19*	*0.065*	*0.11*	87
Benzo(a)anthracene		1.64	*0.32*	*0.17*	*0.22*	88
Benzo(a)pyrene		1.22	*0.25*	*0.093*	*0.19*	90
Benzo(b)fluoranthene		1.89	*0.4*	*0.14*	*0.29*	90
Benzo(ghi)perylene		*0.86*	*0.11*	*0.064*	*0.096*	91
Benzo(k)fluoranthene		*0.75*	*0.16*	*0.070*	*0.12*	88
Chrysene		1.48	*0.30*	*0.12*	*0.21*	88
Dibenzo(a,h)anthracene		*0.22*	< 0.0317	< 0.0293	< 0.0275	91
Fluoranthene		3.67	0.716	*0.30*	0.573	86
Fluorene		*0.47*	*0.082*	< 0.0378	*0.046*	80
Indeno(1,2,3-cd)pyrene		0.977	*0.13*	*0.081*	*0.12*	92
Naphthalene		< 0.137	*0.034*	< 0.0285	< 0.0268	64
Phenanthrene		3.89	0.698	*0.25*	*0.44*	88
Pyrene		4.56	0.805	*0.27*	0.556	96
System Monitoring Cmpds	(% recovery)					
2-Fluorobiphenyl	27-132	87	83	79	78	37
Nitrobenzene-d5	24-119	77	70	65	64	33
p-Terphenyl-d14	24-162	138	129	88	109	47
	Italic results are detections below Practical Quantitation Level (PQL)					
	Bold results are outside QC criteria					

ATTACHMENT 6

STANDARDIZED EQUATIONS BASED UPON USEPA SOIL SCREENING GUIDANCE FOR THE SOIL TO GROUND WATER MIGRATION PATHWAY (REFERENCE [11], PAGES 1-5)

STANDARDIZED EQUATIONS BASED UPON USEPA SOIL SCREENING GUIDANCE FOR THE SOIL TO GROUND WATER MIGRATION PATHWAY

A CONSERVATIVE FATE AND TRANSPORT MODEL WHICH IS DEPENDENT UPON SOURCE TERM SIZE, AQUIFER THICKNESS, GRADIENT, AND DISTANCE TO POTENTIAL RECEPTOR TO DETERMINE DILUTION WITHIN GROUNDWATER. NO CHEMICAL ADSORPTION WITHIN THE AQUIFER IS CONSIDERED.

PURPOSE OF SOIL SCREENING LEVELS (SSL) FOR MOUND

The primary purpose of SSLs is to define a level in soil below which no further study or action would be required. Soil screening level calculations are a necessary part of evaluating potential release sites (PRS) to determine whether residual soil contamination poses a threat to ground water. This method is a screening method which will identify any PRS that exceeds a soil screening level concentration. Due to the conservative assumptions, any PRS that does not exceed the SSLs can be considered a non-problem with regard for potential leaching of contaminants into ground water. This method is designed to be a conservative method and is not a full contaminant fate and transport analysis. The assumptions involved are conservative, but site specific. If soil concentrations exceed the calculated levels, additional more detailed site-specific contaminant fate and transport models will be used to determine whether remedial action is needed.

The Mound plant is assumed to continue in an industrial/office park type of land use. Bedrock ground water within the Mound Plant property boundaries will be evaluated to residential standards and MCLs where it migrates across the property boundary towards credible potential receptors or where it may flow into the Buried Valley Aquifer (BVA). It is assumed that there will be no production of bedrock ground water within the site boundaries due to relatively low well specific capacities that would not support industrial activities.

DEVELOPMENT OF SOIL SCREENING LEVELS (SSL) FOR MOUND

The soil screening equations for the migration to the ground water pathway are developed to identify chemical concentrations in soil that have the potential to contaminate ground water. Migration of contaminants from soil to ground water can be thought of as a two-stage process: (1) the release of contaminants in soil leachate and (2) the transport of the contaminant through the underlying soil and aquifer to a receptor well. The equations consider both of these fate and transport mechanisms in developing SSLs that are protective of human health through the migration to ground water pathway. To be used for early PRS evaluation, the methodology needs to be easily applied.

Soil Screening Level (SSL): a chemical concentration in soil below which there is no concern under CERCLA for ingestion, inhalation, and migration to ground water exposure pathways, provided certain conditions are met.

Simple Site-Specific Method: standardized equations to calculate SSLs with easily obtained site-specific data.

Direct ingestion and inhalation of soil volatiles and fugitive dusts:
The Soil Screening framework differs from a site-specific estimate of risk in that the exposure equations and models are run in reverse to back-calculate to an "acceptable level" of contaminant in soil. Toxicity criteria are used to define the acceptable level: a level corresponding to a 10^{-6} risk for carcinogens and a hazard quotient (HQ) of 1 for non-carcinogens. The concept of back-calculating to an acceptable level in soil was presented in RAGS Part B (US EPA, 1991). This is the method utilized to obtain the current Mound Plant PRGs (DOE, 1994).

Migration to ground water:
For the migration to the ground water pathway, SSLs are back-calculated from acceptable ground water concentrations which are maximum contaminant levels (MCLs), or health-based limits (HBLs) calculated at the target risk levels. There are two parts to the ground water migration pathway:

1. Leaching from the soil into the ground water immediately below the source term.

2. Contaminant fate and transport to the potential receptor. Depending upon site-specific conditions the receptor may be considered to be at the source term or at some distance down gradient. The results of the model will be a dilution factor which will be used to modify the back-calculated soil concentrations.

ASSUMPTIONS FOR SOIL TO WATER LEACHING

1. There is no allowance for chemical degradation or volatilization. The source does not decrease in concentration over time. This assumption is conservative, especially for the small sites at Mound.

2. Adsorption is linear with concentration. This is valid for low concentrations (e.g. in the low ppb range) of most chemicals and for halogenated hydrocarbons, polynuclear aromatic hydrocarbons, benzene and chlorinated benzenes at higher concentrations.

3. The soil and pore water concentrations are at equilibrium with respect to adsorption. This assumption is conservative. The concentration in the pore water will be less than predicted by the calculations if equilibrium conditions are not met.

4. Adsorption is reversible and instantaneous. This is conservative as desorption is usually a slower process than adsorption and some chemicals may never completely desorb.

5. Soil contamination extends from the surface to the water table. In reality the source often does not extend to the water table. This is a conservative assumption

6. The potential receptor well is within the plume.

ASSUMPTIONS FOR GROUND WATER MIGRATION AND DILUTION

1. No chemical dispersion is accounted for. This is conservative in that chemical concentrations will be over estimated by these equations.

2. No adsorption within the aquifer in accounted for. This is conservative as the chemical concentrations will be over estimated.

3. Mixing is due only to horizontal trasnport and dilution by infiltrating rain water. Flow is assumed to by laminar and follows Darcy's Law. If Darcy assumptions are incorrect and flow becomes turbulent, the mixing is more complete than would be predicted by the equations.

4. The aquifer is assumed to act as an equivalent porous media. On the scale of transport at Mound, the fractured bedrock will not have preferential fracture transport pathways.

The equations incorporate a standard linear equilibrium soil/water partition equation to estimate contaminant release in soil leachate (equations 1 & 2) and a simple water-balance equation that calculates a dilution factor to account for dilution of soil leachate in an aquifer (equations 2 & 3). The dilution factor represents the reduction in soil leachate contaminant concentrations by mixing in the aquifer, expressed as the ratio of leachate concentration to the concentration in ground water at the receptor point (receptor well or point of compliance).

Simple PRS or Release Block SSLs are back calculated from acceptable ground water concentrations (i.e. non-zero MCLs). First the acceptable ground water concentration is multiplied by the dilution/attenuation factor (DAF) to obtain a target leachate concentration. For example, if the DAF is 10 and the acceptable ground water concentration is 0.05 mg/L, the target soil leachate concentration would be 0.5 mg/L. The partition equation (equation 1) is then used to calculate the total soil concentration or soil screening level (SSL) corresponding to this soil leachate concentration.

1.0 SOIL LEACHING

Utilizing the calculated guideline values for ground water (acceptable water concentration) from HAZWRAP, a corresponding soil concentration or soil screening level (SSL) can be calculated from:

$$SSL = C_w\{K_d + (\theta_w + (\theta_a H'))/\rho_b\} \qquad \text{(Equation 1)}$$

$$K_d = K_{oc} * f_{oc} \qquad \text{(Equation 2)}$$

where

Parameter	Definition	Units
C_w	target soil leachate. Acceptable water concentration • DAF	mg/L
K_d	soil-water partition coefficient (K_{oc} • f_{oc} for organic chemicals)	L/kg
θw	saturated porosity	
θa	air filled porosity	
H	Henry's Law constant • 41 (0 for metals and radionuclides)	
ρ_b	dry soil bulk density	kg/L
K_{oc}	soil organic carbon/water partition coefficient	L/kg
f_{oc}	fraction organic carbon in soil	

2.0 DILUTION/ATTENUATION

As contaminants in soil leachate move through the soil and ground water, they are subjected to physical, chemical, and biological processes that tend to reduce the eventual contaminant concentration at the receptor point. The processes include adsorption onto soil and aquifer media, chemical transformation, biological degradation, and dilution due to mixing of the leachate with ambient ground water. The reduction in concentration can be expressed by the DAF, which is defined as the ratio of contaminant concentration in soil leachate to the concentration in ground water at the receptor point. The DAF is used to back-calculate the target soil leachate concentration from an acceptable ground water concentration.

This simple site-specific model addresses only one of these dilution-attenuation processes: contaminant dilution in ground water. A simple equation, broken into two parts for ease of use, derived from geohydrologic water-balance relationships is used. This simplifying use of only ground water dilution is used for several reasons.

First, the assumption that the source will last infinitely, results in all subsurface adsorption sites being eventually filled and no longer available to attenuate contaminants. Second, soil contamination is assumed to extend to the water table, eliminating attenuation processes in the unsaturated zone. Finally, chemical specific biological and chemical degradation rates are not known for many chemicals and where they are known there is a wide range in values.

MIXING ZONE DEPTH (d)

One aspect of the model is the determination of the depth that a contaminant leachate will mix in the aquifer. This is called the mixing zone depth and it is dependent upon the rainfall infiltration rate, the length of the source term parallel to the ground water flow direction, the horizontal distance to a potential ground water receptor, and the hydraulic gradient. The mixing zone depth equals the thickness of the saturated portion of the aquifer if mixing is completely effective. This can occur if the aquifer is relatively thin and the distance to the potential receptor is relatively great.

$$d = (0.0112(L+x_r)^2)^{0.5} + d_a\{1 - \exp[(-in(L+x_r))/Kid_a]\} \qquad \text{(Equation 3)}$$

where

Parameter	Definition	Units
L	source length parallel to ground water flow	m
d_a	aquifer thickness	m
K	hydraulic conductivity	m/y
i	hydraulic gradient at the source	m/m
x_r	horizontal distance to receptor	m
in	infiltration rate	m/y

~~Equation 2 assumes that~~ The mixing depth cannot exceed the thickness of the aquifer. The equation is composed of two terms. The first term relates vertical mixing due to horizontal ground water flow, the second term relates the downward infiltration component due to rainfall recharge.

For Mound we assume that ground water contaminants from potential release sites that overlie the bedrock will be governed by this equation. This mixing zone depth equation is appropriate for use at PRSs that directly overlie the BVA, however the distance to the receptor must be assumed to be 0 m.

Once the mixing zone depth has been calculated, the actual dilution-attenuation factor (DAF) is calculated from the following equation:

$$\mathbf{DAF = 1 + Kid/inL} \qquad \textbf{(Equation 4)}$$

where the parameters are the same as in equation 2 and d = the mixing zone depth (equation 3).

Equation 3 incorporates the result of the calculated mixing zone depth with the volume of water that is traversing beneath the contaminant site. This is the effective dilution that occurs in the aquifer. This dilution could be as low as a factor of 1 if it is assumed that a receptor well is located within the leachate at the source term.

* **The calculated DAF shall be multiplied by the acceptable soil leachate concentration (back calculated from MCLs or risk derived concentrations) to obtain the target soil leachate concentration (C_w). The target soil leachate concentration is utilized in equation 1 to obtain the site specific SSL.**

Additional dilution takes place when the migrating contaminant joins the BVA. It is reasonable to assume that any well that a resident installs for drinking water in the BVA is unlikely to located exactly at the edge of the BVA. This additional mixing that will take place is not accounted for in this SSL model. The assumption that the potential receptor is at the exact edge of the BVA, where the aquifer is too thin for a productive well is conservative.

SITE SPECIFIC DATA VALUES

These equations require site specific data for:

Parameter	Definition	SM/PP Hill top soil	Main Hill top soil	Units
L	source length parallel to ground water flow	45	45	m
d_a	aquifer thickness (DOE 1994)	10	15	m
K	hydraulic conductivity (DOE 1994)	52	52	m/y
i	hydraulic gradient at the source	site specific	site specific	m/m
x_r	horizontal distance to receptor	site specific	site specific	m
in	infiltration rate (Schairbaum & Frost 1988)	0.15	0.15	m/y
K_d	soil-water partition coefficient (K_{oc} * f_{oc} for organic chemicals)	chemical specific	chemical specific	L/kg
θ_w	saturated porosity	0.15	0.15	
θ_a	air filled porosity	0.28	0.28	
H	Henry's Law constant * 41 (0 for metals and radionuclides)	chemical specific	chemical specific	
ρ_b	dry soil bulk density	1.5	1.5	kg/L
K_{oc}	soil organic carbon/water partition coefficient	chemical specific	chemical specific	L/kg
f_{oc}	fraction organic carbon in soil (DOE Mound Plant Database)	0.02	0.02	

SOIL POROSITY AND DENSITY DETERMINATION

Although the soils at Mound rarely extends completely to the aquifer, a conservative assumption is that the soils do extend to the aquifer, providing a larger potential source that can desorb contaminants into the ground water.

The determination of the average soil pH is 7.45 from the Mound Plant site specific soil database.

The Mount Plant surface soils are typical of loam type soils. The f_{oc} from the Mound Plant soil database is 2.0%. There are no site specific values obtained for the soil bulk density or porosity. The default values that USEPA (USEPA, 1994) provides will be used in these equations.

HYDRAULIC GRADIENT DETERMINATION

The hydraulic gradient for a given PRS will be determined from nearby wells, or will be determined to be the same as the slope of the topography (or bedrock in fill areas) at the PRS location.

DISTANCE TO A POTENTIAL RECEPTOR

The distance to a potential receptor will be determined to be along the ground water flow direction until ground water encounters the edge of the BVA. The Mound Facility Boundary may be determined to define the distance to a potential receptor if it is deemed possible that a down gradient potential receptor well may be installed at or near the site boundary.

SOURCE LENGTH PARALLEL TO THE GROUND WATER FLOW DIRECTION

The size of the potential source can be quite variable. For PRS evaluation purposes, a length of 45 meters will be used which corresponds to a 1/2 acre potential source area. Soil chemical concentrations for this half acre area will be averaged. For some PRS's, the size is known to be substantially less, and the corresponding smaller value will be used in the equations.

ATTACHMENT 7

EVALUATION OF POTENTIAL FOR LEACHING OF VOLATILE ORGANIC COMPOUNDS (VOCS) AND POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) FROM PRS 106 SOILS INTO GROUNDWATER

EVALUATION OF POTENTIAL FOR LEACHING OF VOLATILE ORGANIC COMPOUNDS (VOCS) AND POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) FROM PRS 106 SOILS INTO GROUNDWATER

Four soil samples were collected and analyzed for VOCs and PAHs during PRS 106 sampling in February 2004. The soil results are shown in Attachment 5 to this document. Those results are compared below to soil concentration values that could lead to maximum acceptable concentrations of contaminant in the Buried Valley Aquifer (BVA) at its nearest location. Derived soil concentrations of analytes detected in the soil vapor reconnaissance (Attachment 1) are also compared.

The evaluated exposure pathway is comprised of leaching of soil contaminant to groundwater with subsequent transport to receptors at the nearest location of the Buried Valley Aquifer. The methodology for evaluating the exposure pathway was utilized as previously described in Attachment 6 (Reference [11]). Parameters in reference [11] are adjusted for a given location. The most significant input to this evaluation is a concentration of chemical in aquifer water that is considered protective. Using:

a) the acceptable aquifer water concentration,
b) geology-specific parameters that describe migration of groundwater below a soil site to the Buried Valley Aquifer, and
c) chemical-specific parameters that describe the partitioning of chemical from soil into the water that leaches through that soil,

a screening level for contaminant concentration in soil is back-calculated. This is called here the "soil screening level for leaching of contaminant to groundwater", denoted SSL_{LGW}. Input parameters and output soil screening results for PRS 106 are given below.

The site geology-specific input parameters to the model are shown in Table A.

Table A. Site Geology-Specific Model Input Parameters

Parameter Definition	Symbol	Value for PRS 106 soil	Units
source length parallel to ground water flow	L	15	m
aquifer thickness (DOE 1994)	da	15	m
hydraulic conductivity (DOE 1994)	K	52	m/y
hydraulic gradient at the source	i	0.008	m/m
horizontal distance to receptor	xr	150	m
infiltration rate (Schairbaum & Frost 1988)	in	0.15	m/y
soil-water partition coefficient (Koc * foc for organic chemicals)	Kd	chemical specific	L/kg
saturated porosity	θw	0.15	
air filled porosity	θa	0.28	
Henry's Law constant * 41 (0 for metals and radionuclides)	H	chemical specific	
dry soil bulk density	ρb	1.6	kg/L
soil organic carbon/water partition coefficient	Koc	chemical specific	L/kg
fraction organic carbon in soil (DOE Mound Plant Data Base)	foc	0.02	
mixing zone depth	d	15	m
Dilution-attenuation factor (used to multiply the target concentration)	DAF	3.77	

The site specific input parameters utilized at PRS 106 include: source length parallel to groundwater flow, aquifer thickness, hydraulic conductivity, hydraulic gradient at the source, and horizontal distance to receptor. These are further described below:

Source length parallel to groundwater flow direction:
The source length parallel to the groundwater flow direction was selected to approximately match the width of the garage building, namely 15 meters.

Aquifer thickness:
Aquifer thickness in this region is based on results from the OU-9 Hydrogeological Investigation: Bedrock Report, January 1994. Aquifer thickness for this model is 15 meters

Hydraulic conductivity:
Hydraulic conductivity was selected based on results from the OU-9 Hydrogeological Investigation: Bedrock Report, January 1994. Hydraulic conductivity for this model is 52 meters/year

Hydraulic gradient at the source:
The hydraulic gradient at the source was determined by selecting a gradient consistent with gradients used in past calculations on the Main Hill Area. The hydraulic gradient for this model is 0.008.

Horizontal distance to the receptor:
The horizontal distance to the receptor was selected to be consistent with distances used in past calculations on the Main Hill Area. The horizontal distance to the receptor, in this case the Buried Valley Aquifer, for this model is 150 meters

Chemical specific soil/water partitioning parameters for VOC and PAH analytes that were detected in PRS 106 soils are shown in Table B. Table B also gives the concentrations of these chemicals in water that are considered protective. Where available, the Maximum Contaminant Level (MCL) for a chemical in water is used. Where MCL is not available, the more conservative of the 10^{-6} RBGV for a carcinogen in groundwater or 10% of the health-based Hazard Index is used as the acceptable water concentration for evaluation.

SSL_{LGW} values were calculated by the soil leaching model for detected VOC and PAH analytes in PRS 106 soils. The final calculated SSL_{LGW} values for these analytes are shown in the rightmost column of Table B.

Table B. Chemical Specific Model Input Parameters and Calculated SSL_{LGW} values

CHEMICAL NAME	H	Koc (L/kg)	foc	Kd (L/kg)	MCL (mg/L)	10-6 RBGV (mg/L)	HI x 10% (mg/L)	Acceptable Concentra-tion (mg/L)	SSL_{LGW} (mg/kg)
Anthracene	4.55E-03	18162	0.02	363.24	0.007			0.007	9.6
Benzo(a)anthracene	1.48E-04	272847	0.02	5456.94	0.007			0.007	144
Benzo(b)flouranthene	2.53E-04	882588	0.02	17651.76	0.007			0.007	466
Benzo(a)pyrene	3.43E-05	749569	0.02	14991.38	0.0002			0.0002	11.31
Chyrsene	4.96E-05	312425	0.02	6248.5		0.00717		0.00717	168
1,1-Dichloroethane	2.36E-01	35	0.02	0.7			0.916	0.916	2.88
Fluorene	2.99E-03	9226	0.02	184.5			0.409	0.409	284
Fluoranthene	3.83E-04	72025	0.02	1440.5			0.0383	0.0383	208
Indeno(1,2,3-c,d)pyrene	1.99E-07	4364700	0.02	87294		2.27E-05		2.27E-05	7.47
Napthalene	1.98E-02	1549	0.02	30.98			0.0973	0.0973	11.4
Pyrene	3.39E-04	59865	0.02	1197.3			0.307	0.307	1387
Toluene	2.52E-01	171	0.02	3.42	1			1	13.42
Tetrachloroethene	7.09E-01	138	0.02	2.78	0.005			0.005	0.057
1,1,1-Trichloroethane	7.63E-01	110	0.02	2.2	0.2			0.2	1.83

The calculated SSL_{LGW} values are compared to the highest detected concentrations of VOCs and PAHs in PRS 106 soils in Table C below.

Table C. Comparison of SSL_{LGW} values to results at PRS 106

CHEMICAL NAME	SSL_{LGW} (mg/kg)	Highest Soil Result (mg/kg)
Anthracene	9.6	0.928
Benzo(a)anthracene	144	1.64
Benzo(b)flouranthene	466	1.89
Benzo(a)pyrene	11.31	1.22
Chyrsene	168	1.48
1,1-Dichloroethane	2.88	<0.021 *
Fluorene	284	0.47
Fluoranthene	208	3.67
Indeno(1,2,3-c,d)pyrene	7.47	0.977
Napthalene	11.4	<0.137
Pyrene	1387	4.56
Toluene	13.42	0.00115
Tetrachloroethene	0.057	0.00131
1,1,1-Trichloroethane	1.83	0.052 *

*Calculated using Attachment 2 methods and Attachment 1 soil vapor results.

Note that if no SSL_{LGW} was calculated for a detected PAH (e.g., phenanthrene) or VOC (e.g., 4-methyl-2-pentanone), either no risk-based groundwater threshold exists or no chemical parameters were available in EPA Guidance. The concentrations of the detected analytes that are not listed in Table C are extremely low and largely limited to sample PRS-106A. This soil is not expected to be sufficiently contaminated to negatively impact the groundwater system via leaching

Discussion of Results

In all cases the highest analytical soil result is less than the calculated SSL_{LGW}. The input parameters selected for calculation of the SSL_{LGW} are conservative and therefore the compounds detected in the soils pose no risk via leaching to the underlying groundwater system.